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Professional Development

The goals of professional development are to provide classroom teachers with the knowledge and skills they will need to implement the mathematics content standards and to ensure that prospective teachers will be prepared to teach mathematics effectively. Assistance in achieving these goals is provided through the topics addressed in this chapter: district programs for professional development, professional development and retention of new teachers, long-term professional development, issues to consider in designing professional development programs, issues to consider in implementing new curricula, and undergraduate preparation.

District Programs for Professional Development

Because the new standards are extremely rigorous, implementing them presents a challenge to teachers and students. While the standards articulate what students need to know and be able to do to compete in a global economy, most California students currently perform at unacceptably low levels. The challenge of implementing the standards will be daunting because (1) the significant number of students not currently performing at the levels expected by the standards means that instruction will need to be organized and presented efficiently and effectively; and (2) the increased rigor of the standards will require many teachers at all levels to become more knowledgeable about mathematics and ways in which to teach it.

Given the enormity of the challenge, teachers must learn the most effective techniques for teaching mathematics, such as those described in Chapter 4, "Instructional Strategies." Teachers must be prepared to address the needs of all their students. In some schools teachers will find that most students have a wide background and understanding of mathematics. In other schools teachers will encounter large numbers of students who have not learned foundational content. The professional development for teachers in the short term must be geared to the specific challenges that teachers will face in implementing the standards in their classrooms. Teachers need information based on what has been proven to work with students. Professional development should be based only on proven techniques and theories.

Ongoing professional development is expected of all teachers. Professional development for immediate classroom application should take place locally and regularly. Effective professional development is long term and focused on increasing teachers' mathematical knowledge and ability to teach the subject.

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Professional Development and Retention of New Teachers

All too often, new teachers leave the profession during or just after their first year of teaching, thereby wasting much of the huge investment in their education. To help in solving this problem, school administrators and colleagues must take steps to help new teachers succeed in the classroom. Careful placement and

active mentoring can help, as can the activities for all teachers discussed next. These activities can alleviate the isolation that can be a problem for all teachers but which is most acute during the first year of teaching.

To overcome the potential for isolation, teachers should be encouraged to set up ongoing collegial support, the focus of which is to share successful lessons and teaching approaches, and to coach one another in ways to improve student achievement. School and district administrators should support such in-house efforts by making time and space available and, when possible, by bringing in qualified mathematics specialists to help with these developmental activities.

All professional development programs that focus on mathematics should use this framework to address the needs of the teachers involved. Further, teachers should be active participants in planning and organizing meetings and attending short courses and workshops offered by local districts, colleges, universities, independent consultants, and professional organizations to ensure that the teachers' needs are being met. These programs must be assessed independently to determine their usefulness to teachers; for example, by leading to improvement in student mathematics achievement.

Long-Term Professional Development

One goal of long-term professional development is to sustain and increase teachers' understanding of mathematics; that is, teachers' procedural competencies, conceptual knowledge, and ability to use these competencies and knowledge in problem-solving situations.

Long-term professional development must be expected, actively encouraged, and rewarded both by school administrators and by state and national efforts. Support from institutions of higher education and other institutions with sufficient expertise must be enlisted in an effort to make opportunities for high-quality, long-term professional development readily available to all mathematics teachers. Long-term professional development programs in mathematics should be routinely subject to external assessment to ensure that they achieve their goals toward enhancing the mathematical competencies and knowledge of teachers. Teachers should be encouraged to share the benefits of their long-term professional development, as appropriate, with their colleagues in local in-service training programs. Teachers' leadership and participation in national and local professional organizations that support the spirit and letter of this framework and the state standards are valued as a hallmark of the teachers' professionalism.

Since professional development is essential to implementing the high standards defined within this framework, a variety of issues should be considered when such activities are being designed. The list of issues that follows is neither a check-off list of what should be done nor an exhaustive compilation of items. Indeed, any particular focused and in-depth professional development program may be able to deal with only a few issues each year. In deciding how to balance these considerations, teachers and school district administrators need a clear understanding of their goals for professional development.

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Issues to Consider in Designing Professional Development Programs

Persons planning activities or programs for professional development need to consider the following issues:

- The emphasis and focus of all professional development programs in mathematics are on the effective implementation of the state standards and the guidelines presented in this framework. Individuals who provide professional development programs must be willing and able to demonstrate the effectiveness of their recommendations for the typically diverse California classroom. *Those teaching mathematics to teachers must themselves be competent with mathematics and competent teachers of teachers.* Teachers of classroom management must be competent at managing classrooms effectively, and those helping teachers learn effective instructional strategies must be competent themselves at demonstrating any such strategies in classrooms.
- Programs with lasting influence are usually long term and locally based, with teachers playing a substantial role in planning and implementation. The program should receive regular feedback from teachers and be modified accordingly.
- Effective professional development is needed to enable teachers to maximize instructional time. Teachers can be helped in resolving both mathematics-specific classroom management issues (e.g., organizing, distributing, or collecting concrete materials) and more generalized management concerns (e.g., dealing with an inappropriately high classroom noise level, frequent tardiness or absences, or inattention).
- Program activities should be structured to raise teachers' proficiency in mathematics. As their proficiency increases, teachers will find that their comfort levels in using their new mathematical knowledge will also increase.
- Program participants need to discuss and understand fully what it means to balance the learning of mathematical procedures, the understanding of mathematical concepts, and the ability to engage in mathematical problem solving across different grade and achievement levels (see Chapters 1 and 4).
- Programs need to help teachers and administrators, through in-service training and sharing, expand their understanding of student differences, diverse cultures, and specific instructional implications and accommodations.
- Teachers, while accommodating differences among students, must know which standards provide the core mathematics foundation for all students at each grade level (see Chapter 3, "Grade-Level Considerations").
- Parent involvement can substantially influence student success (Slavin, Karweit, and Wasik 1994). Programs should help teachers develop various strategies to help parents become effectively involved in the mathematics education of their children.

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- Professional development programs should focus both on mathematics proficiency for students and on those instructional strategies that best achieve it (see Chapters 1 and 4).
- Teachers need to learn about various forms of assessment, including methods of conducting frequent assessments to monitor students' progress, along with remedies when such assessments reveal that students are not achieving at grade-level expectations.
- Teachers need time to discuss with their peers ways in which to implement concepts that were presented in professional development programs.

Issues to Consider in Implementing New Curricula

Many professional development issues need to be addressed with the implementation of the standards. Some of the more pressing issues are as follows:

- Professional development needs to provide teachers with a clear understanding of standards-based mathematical expectations. Students need to know the goals and uses of the mathematics they are taught (see Chapter 4), and teachers need to understand the basic goals of the standards and the importance of achieving those goals.
- Teachers need to understand how the grade-level content they are teaching is related to the content taught in previous grades and how their teaching will prepare students for the mathematics to be introduced in later grades.
- As described in Chapter 10, "Criteria for Evaluating Mathematics Instructional Materials," well-designed instructional materials will greatly facilitate this goal. But, at the same time, in-service training or other activities will also be needed to show teachers how their teaching is an integral part of all grade-level standards and how they can develop strategies for linking their teaching to material for earlier and later grades (e.g., identifying review materials for improving their students' foundational skills).
- Phase-in strategies for new curricula must be considered carefully. To maintain momentum, teachers should be provided the necessary in-class support to implement new programs consistently and according to a given timeline.

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Every student of mathematics deserves to be taught by a teacher who has both the mathematical knowledge and teaching skills needed to implement the standards at each student's achievement level. The teacher must present mathematics in ways that allow students to experience the excitement and joy of doing mathematics and to attain mathematics proficiency. Such teachers are a precious resource that must be nurtured at all levels and can, as math specialists, assist students and teachers alike. Young adults who love mathematics must be recruited into the profession and supported through preservice preparation and in-service education. They must be helped in (1) learning mathematics; and

(2) developing a repertoire of effective teaching strategies that allow them to implement a curriculum that balances problem solving, conceptual understanding, and procedural skills, as described in Chapters 1 and 4. California's teachers deserve and must receive the greatest possible support in this endeavor so that they can succeed in becoming skilled mathematics teachers.

Given the shortage of highly trained mathematics teachers in California, schools and undergraduate institutions must actively encourage talented mathematics students to go into teaching careers. Undergraduate internships in kindergarten through grade twelve classrooms, followed up with guided reflection and discussion, can be effective recruitment tools and can enhance the value of undergraduate mathematics education.

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Undergraduate Preparation

Teachers need a background in mathematics that is considerably deeper and broader than the mathematics they are expected to teach. Teachers at lower grade levels need this background to understand how their teaching relates to the mathematics content in later grades. Teachers at each grade level need to understand what students will encounter in subsequent grades, because teachers will then know which foundational skills taught at their grade level deserve the greatest attention and emphasis. To achieve this understanding, teachers need to acquire a mathematical breadth that enables them to comprehend the interrelationships of mathematical concepts and procedures across strands. Teachers' mathematical depth should enable them to understand the dependence of mathematical ideas on one another; for example, adding rational expressions in algebra depends on adding fractions in arithmetic.

Teachers in kindergarten through grade six need a command of the mathematics for algebra and geometry described in this framework. Further, before entering a credential program, teaching candidates for kindergarten through grade six should have a full year of mathematics content courses that cover at least the material described in Chapter 3.

Junior high school and middle school mathematics teachers need a command of mathematics beyond that of kindergarten through grade six teachers. Before entering a credential program, teacher candidates for junior high school and middle school mathematics should have at least 24 semester hours of courses that are a part of an approved kindergarten through grade twelve mathematics credential program.

Before entering a credential program, high school mathematics teacher candidates need the full background required for state secondary certification in mathematics. College and university mathematics departments should design their programs so that their students majoring in mathematics do not encounter unnecessary obstacles in meeting the state requirements.